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# Effect of post-harvest coating treatments on physical characteristics of guava fruit (*Psidium guava* L.) during storage

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**Abstract**
The fruits of guava are highly perishable and require strategies to enhance the post-harvest life for extending the fresh fruit market period. The present investigation was conducted at Horticulture Laboratory, Department of Horticulture, Lovely Professional University, Phagwara, Panjab, during the year 2021-2022. The experiment was carried out to study the storage stability of guava fruits under ambient conditions. The experimental material consisted of 7 treatments and coating *viz*. Chitosan (2%) *Aloe vera* (50%) along with ascorbic acid as coating additives alone and in different combinations of coating materials. The observation was recorded on the $1^{st}$, $3^{rd}$, $5^{th}$, $7^{th}$, and $9^{th}$ day of the storage. Fruits under control were survived only for 5 days and with *Aloe vera* 50% and Chitosan 2% coated for 7 days. Whereas, shelf life was extended up to 9 days with other combinations of coatings. The results revealed a minimum physiological loss in weight and Fruit weight, maximum Firmness, specific gravity, and the organoleptic score were observed with the treatment of *Aloe vera* (50%) + chitosan (1%) + Ascorbic acid (1%) during storage.

**Keywords:** Guava fruit, *Aloe vera* gel, chitosan, ascorbic acid, physical parameters

## 1. Introduction
Guava (*Psidium guajava* L.) is one of the most well-known edible tree fruits grown widely in more than sixty countries throughout the tropical and sub-tropical regions in the world. Guava is also known as 'The apple of the tropics', it is one of the most delicious and nutritious fruit crops grown in India. Guava is considered to be superior to several other fruits by virtue of its commercial and nutritional value (Menzel, 1985) [10]. The fruits are delicious and rich in vitamin 'C', pectin, and minerals like calcium, phosphorous, and iron. Guava fruits are normally consumed as fresh or processed into several products like jam, jelly, cheese, nectar, paste, etc. (Boora, 2012) [1]. There is a great demand for guava fruits in both domestic and international markets for fresh and processing purposes. Guava is a perishable fruit and is highly prone to bruising and mechanical injuries. Due to such perishability, control of fruit ripening is fundamental and this generates the necessity to search for new technologies to increase shelf life, reach distant markets and thus improve the marketing process (Metra *et al*., 2012).
Recently the use of Aloe-Vera gel as the edible coating material is increased for fruits driven by its antifungal activity. Aloe-Vera gel-based edible coating has been shown to prevent loss of moisture and firmness, control respiratory rate and maturation development, delay oxidative browning and reduce microorganism proliferation. It has antifungal and antibacterial property which provides a defensive barrier against microbial contamination of fruits and vegetables. The main goal is to prepare aloe-Vera gel coating tings as an effective preservative to improve the safety, quality, and functionality of fruits and vegetables (Singh *et al*., 2018) [17].
Chitosan (polyβ-(1-4) N-acetyl-d-glucosamine), is a high molecular weight cationic polysaccharide. Chitosan is obtained through the DE acetylation reaction of chitin. Commercially, chitin is available in large amounts as it can easily be extracted from shells of prawns, crabs, etc. which are by-products of the shellfish industry. Chitosan is popular among edible coating materials as it is biodegradable, biocompatible, and highly resistant to microbial attack (Duan *et al*., 2019) [3].
Ascorbic acid (AA) is the most abundant antioxidant in nature. AA and its derivate have been used as an antioxidant and anti-browning agent in edible coatings to retain the postharvest quality of fresh-cut fruits and vegetables (Tapia *et al*., 2008; Xing *et al*., 2010) [21].

AA in combination with calcium salts and organic acids prevents browning and membrane breakdown by controlling the activity of polyphenol oxidase (Oms-Oliu *et al*., 2010) [13]. AA has also shown antibacterial properties for fresh-cut Bananas (Yurdugül, 2016), Apples (Qi *et al*., 2011) [15], and papaya (Tapia *et al*., 2008). Mostly, AA and its derivates have been used as anti-oxidative, anti-browning, and antibacterial agents (Sogvar *et al*., 2016) [18]. The aim of this work was to study the effect of chitosan, alovera along with Ascorbic acid applied as an edible coating on the change in physical characteristics of Guava quality during storage and its role in extending the shelf life of guava fruits.

## 2. Materials and Methods

### 2.1 Collection of fruits

Guava fruits was selected for this experiment. The fruit shape is round, smooth skin, white pulp, soft, firm light yellow, and on ripening develops a very sweet taste. Guava fruits were collected from Lovely Professional University (horticulture field) in the Jalandhar district. *Aloe vera* leaves were collected from Lovely professional university (Laboratory).

### 2.2 Preparation of Coating materials

#### 2.2.1 *Aloe vera* coating

*Aloe vera* leaves were collected and washed with distilled water, the *Aloe vera* gel matrix was separated from the outer cortex of the *Aloe vera* leaf and the colorless hydro parenchyma was blended in a mixer. The resultant matrix was filtered to remove fibers. The liquid obtained from the leaves containing fresh *Aloe vera* gel 300ml *Aloe vera* gel was heated at 100 °C for 4 minutes. The gel was cooled and citric acid 1.2g for 300ml *Aloe vera* gel was added to maintain the pH of the *Aloe vera* gel.

#### 2.2.2 Chitosan coating:

To prepare the chitosan coating solution, 2g of chitosan in 100ml of distilled water, and 0.5ml glacial acetic acid were added to dissolve the chitosan. The pH value of the chitosan solution was adjusted to 6.0 with 1.0 mol/l NaOH. After coating the cloth, the fruits were stored at room temperature.

#### 2.2.3 Ascorbic acid coating

An ascorbic acid solution is prepared by dissolving 1g of ascorbic acid in 100ml of distilled water.

### 2.3 Fruit coating processes

Uniformly matured and disease-free fruits were collected. (First washing and drying of fruits then preparation of coating materials then application of coating by smooth cloth). A set of 31.5 kg fruits with 1.5kg fruits per replication were taken each of the following treatments having three replications. Treated fruits were kept in green color clothes under ambient conditions. Observations were taken in three intervals on the 1st, 3rd, 5th 7th, and 9th day. The fruits were subjected to coating of following treatments: $T_1$-Control, $T_2$- *Aloe vera* 50%, $T_3$-Chitosan 2%, $T_4$- *Aloe vera* 50% + Ascorbic acid 1%, $T_5$-Chitosan 1%+ Ascorbic acid 1%, $T_6$- *Aloe vera* 50% + Chitosan 1%, $T_7$- *Aloe vera* 50%+chitosan1%+Ascorbic acid 1%. Determined the PLW (%) of guava fruits, the initial weight was recorded and the total loss of physiological weight was then calculated by subtracting the final weight of the fruits from the initial weight. weight of the fruits was taken on top pan electronic balance during storage and expressed in grams. Specific gravity was calculated following the water displacement method. The firmness of fruits was determined by a penetrometer and expressed by kg/m$^2$. Organoleptic score determined as per hedonic scale.

## 3. Results and Discussion

### 3.1 Physiological loss in weight (%)

A perusal of data presented in Fig 1 revealed that the significant effect of *Aloe vera* (50%) + chitosan (1%) + Ascorbic acid (1%) treatments were found for PLW during the storage period. PLW increased during the storage period regardless of treatments. Fruits under control were not survived on day 7 whereas fruits in $T_2$ and $T_3$ treatment not survived on day 9. On 5th day of storage, the minimum PLW was recorded under treatment $T_7$ (7.54%) and maximum in $T_1$ (14.45%), and the rate of increase in weight loss in all the treatments were significantly different from each other up to 9th day. At the end of storage lowest PLW activity (9.33%) was observed in $T_7$ treatment and the maximum (12.98%) in $T_4$ treatment.

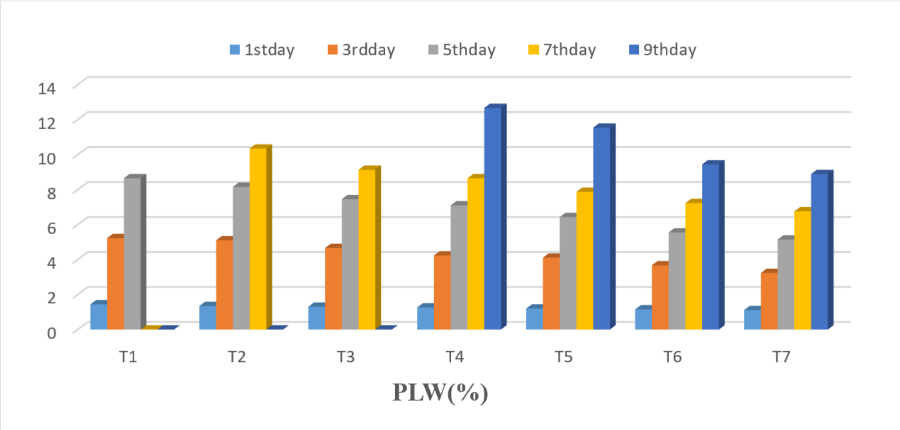


**Fig 1:** Effect of edible coating on Physiological loss in weight (%) during storage

### 3.2 Fruit weight (g/fruit)

A perusal of data presented in Fig 2 revealed the significant effect of *Aloe vera* (50%) + chitosan (1%) + Ascorbic acid (1%) treatments were found for fruit weight during the storage period. The fruit weight decreased irrespective of treatments in the storage duration. Fruits under control were not survived on day 7 whereas fruits in $T_2$ and $T_3$ treatment not survived on day 9. On 5th day of storage, the minimum fruit weight was recorded under treatment $T_7$ (78.0g/fruit) and maximum in $T_1$ (94.70g/fruit), and the rate of increase in weight loss in all the treatments was significantly different during storage. At the end of storage lowest fruit weight (71.41g/fruit) was observed in $T_7$ treatment and the highest (77.51g/fruit) in $T_4$ treatment. The afraid results indicate PLW enhanced and fruit weight decreased with increasing the storage period in all treatments. This might be due to the coating acting as a barrier to moisture loss from the fruit surface. These results are in close conformity with the finding of Jagadeesh and Rokhade (1998) [4]. These findings are also supported by the observations of Martinez *et al.*, (2006) [8, 9] in *Aloe vera* gel-coated grapes. Liu *et al*. 2007 [6] and Wijewardane (2009) in coated apple.

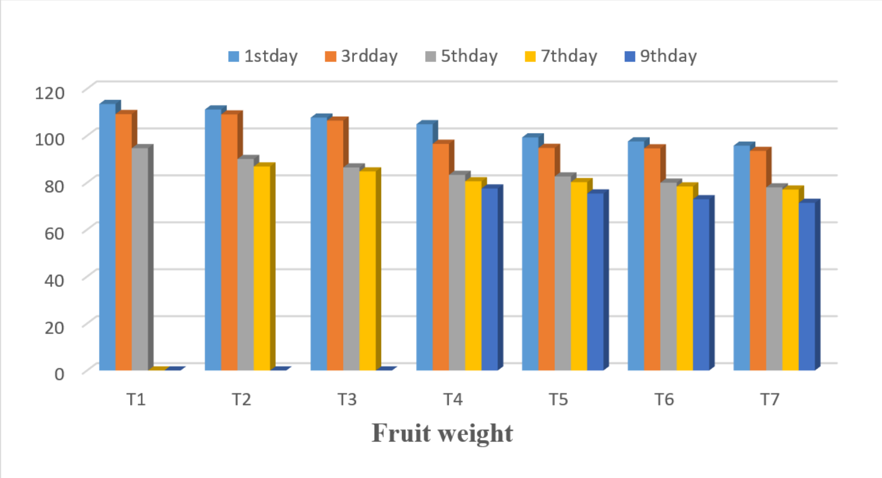


**Fig 2:** Effect of edible coating on fruit weight during storage

### 3.3 Specific gravity

A perusal of data presented in Fig 3 revealed that the non-significant effect of *Aloe vera* (50%) + chitosan (1%) + Ascorbic acid (1%) treatments were found for specific gravity during the storage period. The specific gravity increased irrespective of treatments in the storage duration. Fruits under control were not survived on day 7 whereas fruits in $T_2$ and $T_3$ treatment not survived on day 9. Therefore, observations were discontinued for $T_1$ and $T_2$, $T_3$ after day 5 and 7, respectively. On 5th day of storage, the minimum specific gravity was recorded under treatment $T_1$ (0.68%) and maximum in $T_7$ (1.00%), and the rate of increase in weight loss in all the treatments was significantly different during storage. At the end of storage lowest specific gravity observed in treatment $T_4$ (0.33%) and highest specific gravity in treatment $T_7$ (0.78%). The specific gravity is found to decrease during the storage period. It means that the depletion of fruit weight is more than the corresponding decrease in its volume. A decrease in fruit moisture content is the witness to this happening. In addition, accelerated biochemical activities and respiration may have contributed to vanished the fruit voids and hence increase in specific gravity. The migration of biochemical compounds from peel to pulp may also cause an increase in specific gravity (Mohit *et al*., 2019). The results are similar to those provided by Patil and Shanmugasundarm (2015).

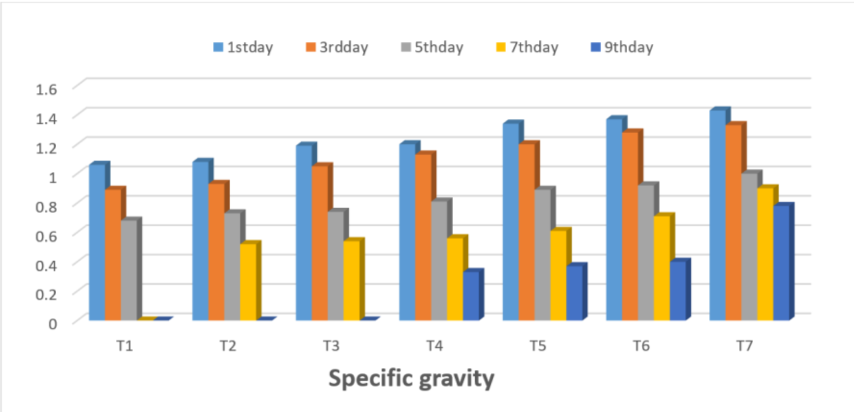


**Fig 3:** Effect of edible coating on Specific gravity during storage

### 3.4 Firmness (kg/cm²)

A perusal of data presented in Fig 4 revealed that the significant effect of *Aloe vera* (50%) + chitosan (1%) + Ascorbic acid (1%) treatments were found for firmness during the storage period. The firmness increased irrespective of treatments in the storage duration. Fruits under control were not survived on day 7 whereas fruits in $T_2$ and $T_3$ treatment not survived on day 9. Therefore, observations were discontinued for $T_1$ and $T_2$, $T_3$ after day 5 and 7, respectively. On 5th day of storage, the minimum firmness was recorded under treatment $T_1$ (0.68 kg/cm$^2$) and maximum in $T_7$ (1.00 kg/cm$^2$), and the rate of decrease in fruit firmness in all the treatments was significantly different during the storage period. At the end of storage lowest firmness (0.33 kg/cm$^2$) was observed in $T_4$ treatment and the maximum (0.78 kg/cm$^2$) in $T_7$ treatment. *Aloe vera* (50%) + *chitosan* (1%) + *Ascorbic acid* (1%) coating showed a higher firmness at 9$^{th}$ day of storage. Mani *et al*. (2017) [7] reported similar findings in the case of ber fruit for 15 days of storage. They also concluded that the higher firmness of the coated fruits may be due to the fact that as respiration rate is reduced also reduced is the degradation of water-insoluble calcium pectate (Ca-pectate) or calcium bridge that renders strength to the fruit skin. According to Keneko *et al*. (2002) [5] coating was the most effective treatment for retardation of softening of harvested fruits and vegetables compared to the uncoated ones.

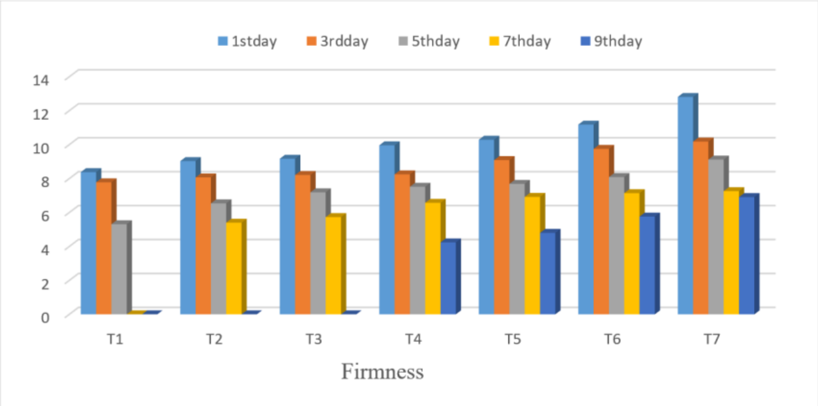


**Fig 4:** Effect of edible coating on Firmness during storage

### 3.5 score

A perusal of data presented in Fig 4 revealed that the significant effect of *Aloe vera* (50%) + *chitosan* (1%) + *Ascorbic acid* (1%) treatments were found for organoleptic score during the storage period. The Organoleptic score increased irrespective of treatments in the storage duration. Fruits under control were not survived on day 7 whereas fruits in $T_2$ and $T_3$ treatment not survived on day 9. Therefore, observations were discontinued for $T_1$ and $T_2$, $T_3$ after day 5 and 7, respectively. On 5$^{th}$ day of storage, the minimum Organoleptic score was recorded under treatment $T_1$ (7.00) and maximum in $T_7$ (8.17). At the end of storage lowest Organoleptic score (5.50) was observed in $T_4$ treatment and the maximum (5.60) in $T_7$ treatment. *Aloe vera* (50%) + *chitosan* (1%) + *Ascorbic acid* (1%) coating showed a higher organoleptic score at 5$^{th}$ day of storage. During storage period the judging panel found that flavor was satisfactory in *Aloe vera* (50%) + *chitosan* (1%) + *Ascorbic acid* (1%) coated guava fruits. Coated guava fruits looked shiny and attractive. The coated fruits did not produce any bad odor or off-flavor. According to the judging characteristics, guava fruit coated with *Aloe vera* (50%) + *chitosan* (1%) + *Ascorbic acid* (1%) had a better appearance than the control fruits. Control guava fruits showed severe symptoms of dehydration during storage periods. None of the judges detected the appearance of off-flavors or aromas in guava coated *Aloe vera* (50%) + *chitosan* (1%) + *Ascorbic acid* (1%). These results are supported by the findings of Brishti *et al*., (2013) [2], Tripathi and Dubey (2004) [19] and Martinez-Romero *et al*., (2006) [8, 9] in papaya, grapes and cherry fruits, respectively.

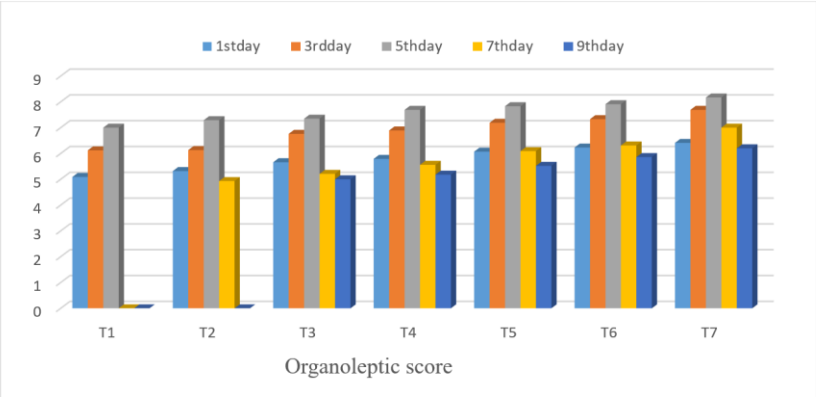


**Fig 5:** Effect of edible coating on Organoleptic score during storage

## 4. Conclusion

It was concluded that the coating of *Aloe vera* (50%) + *chitosan* (1%) + *Ascorbic acid* (1%) was effective in maintaining quality of guava fruits. The fruits retained desirable texture and postharvest quality till the end of their storage life. However, *Aloe vera* (50%) + *chitosan* (1%) + *Ascorbic acid* (1%) coating can be integrated into the supply chain management of guava fruits due to its easy availability and low price to extend storage life, marketability and maintaining quality during transport and storage under ambient conditions.

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